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Cincinnati, Ohio

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ANNUAL REPORT

OF THE

ROBERT A. TAFT SANITARY ENGINEERING CENTER

July 1, 1953 To June 30, 1954

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

CINCINNATI, OHIO

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The "Environmental Health Center" was renamed the "Robert A. Taft Sanitary Engineering Center" by the 83rd Congress early in 1954. The Service and the staff of the Center have appreciated the privilege of having the Center named after a great American.

The new laboratory facilities were completed and occupied during the year. Occupancy of the new quarters was started in September and completed early in December, with construction still pending. For the first time in almost 20 years the equipment and personnel of the Center are located under one roof and in adequate quarters.

A notable group gathered in Cincinnati for the dedication of the Robert A. Taft Sanitary Engineering Center by the Secretary of the Department of Health, Education, and Welfare. Secretary Hobby dedicated the building to the mission of serving as "— a focal point for inquiry and investigation into all the external factors which affect human health."

The year saw geographic rearrangement of activities to expedite the development of program. The Shellfish Sanitation Laboratory was transferred from Woods Hole, Massachusetts, to Pensacola Florida, to permit studies of Gulf Coast shellfish to succeed studies of the shellfish in northern waters. Under a cooperative arrangement with Oregon State College, the Fisheries and Toxicity unit was moved to Corvallis, Oregon. The arrangement with the college permits an expanded program of study of the toxicity of industrial wastes to cold water fishes to be conducted in close cooperation with the Department of Fish and Game Management. In addition to expediting Center studies of fish toxicology, this arrangement will contribute to the training of graduate students in fish toxicology and bioassay procedures.

AIR POLLUTION STUDIES

The total scope of the research program has been definitely widened by the assignment of responsibility of air pollution research to the Center on July 1, 1953. Critical examination of the Nation's need for further knowledge concerning air pollution led to formulation of the following program.

1. A study of the particulate content of metropolitan air supplies in 30-40 American cities.
2. The development of practicable techniques for the determination of volatile and gaseous contaminants in air.
3. Dual examination of mortality statistics as related to meteorological conditions, to ascertain whether there exists any causative relationship between unusual weather conditions, entailing unusual concentrations of air pollutants, and abnormal mortality experience.
4. The development of survey methods for air pollution studies on a regional basis.
5. Establishment of the nature and amount of air pollutants caused by specific important sources of air pollutants, such as automotive operation, incinerators, specific types of industrial operations, and other air polluting effluents which occur frequently.
6. Studies of the physiological effects of air pollutants.

Along with other air pollution responsibilities, the Center has taken over the conduct of specific studies of air pollution problems in the Detroit-Windsor area which are being conducted on reference from the International Joint Commission. This includes critical study of the smoke problem along the international waterway, as well as participation in a cooperative pilot health study in the city of Detroit.

The study of the particulate content of air in typical American cities received first priority for activation. Techniques and machines for the collection and measurement of particulate matter in air were devised. A nation-wide sampling network was established. The laboratory procedures required for evaluation of the collected particulate matter were studied and tentative routines selected. Interesting and important facts are already starting to emerge from this work. Anchorage, Alaska, deluged with volcanic dust recently, is observed to have several times as much dust in its air as any other American city except when snow covers the ground and lays the dust.

In the wake of a multitude of atomic tests, new radioactivity has been noted in particulate matter in air all over the U. S. The amount present, while not now a health hazard, is definitely ponderable and constitutes a new characteristic of the personal environment. Allergenic material, as evidenced by proteinaceous material is showing new and interesting patterns, and frequently city air contains more potential allergens than the air of the surrounding countryside.

WATER POLLUTION, WATER PURIFICATION, AND WATER QUALITY CONTROL

The Center's research program continues to consider important problems related to total water use. With some problems, there were several concurrent investigations related to different phases of the same situation. The current trend toward increasing replacement of soaps by synthetic detergents has caused new and important difficulties in sewage disposal, water pollution, and water purification. Center activity this year developed a procedure for separation, recovery, concentration, and definite identification of the material which formed a heavy foam on the Ohio River at Wheeling, West Virginia at a time when great difficulty was experienced in the operation of the water plant. The material proved to be a synthetic detergent identical in properties with that contained by certain commercial formulations. Concurrently, improved quantitative procedures for the detection of trace amounts of detergents in water supplies were being developed. In another study aimed at assessment of synthetic detergents, it was found that the complex phosphates they contain could cause more difficulty in water filtration than the detergent materials present.

Substantial progress has been made on the development of a machine for recording the dissolved oxygen content of polluted water, and laboratory shakedown evaluation is nearing an end. The Center has reason to hope that in the near future it can describe details of a machine which will faithfully and continuously record the oxygen content of important streams at oxygen gauging stations, or which can be mounted in a boat to make a quick, accurate, oxygen survey of long stretches of water. A new and exceedingly powerful water pollution study and control tool appears now to be a definite prospect.

The control of the biological quality of water and drinking water, and the assessment of important factors therein continues to receive active

and well deserved interest. The use of membrane filter techniques in water quality control has undergone further development and evaluation. The membrane filter technique, while not yielding results exactly comparable to the MPN technique, has been developed into a powerful tool for use in water quality control and investigations.

In explaining the waterborne transmission of virus material, interesting new data have been developed. There is confirmed evidence that in Ohio River water, the coxsackie virus is inactivated at a rapid rate. Further work in progress seeks to discover the mechanism of the inactivation of the virus in the river water.

The growing problem of the effect of algal growth on water quality has received continued attention. Eighty compounds have been given laboratory screening for algaecidal properties. This work included evaluation of general algaecidal effectiveness, and determination of effectiveness against specific species. After evaluation of the fish toxicity of promising materials, likely materials were field tested. This work has developed the important information that pretreatment of impounded water with persistent algaecides to prevent the appearance of algae in impounded water is frequently more economical and satisfactory than efforts to cope with algae blooms as they occur. 3 (p-Chlorophenyl) 1,1 dimethyl urea shows promise as a superior algaecide for both pretreatment practice or control of existing growth.

Studies of fish toxicology have developed significant data. The toxicity of cyanide and cyanide complexes was found to be subject to extreme variation as a function of pH. For instance, a drop in pH from 8 to 6.5 causes a thousand-fold increase in the toxicity of nickelo cyanide to fish. Water composition may have extreme effects on fish toxicity. In soft water Beryllium is ten times as toxic to fishes as in hard water; for a uranium

salt, the corresponding factor is 100. Fluoride has shown up as one of the rare compounds having much lower toxicity to fishes than to humans drinking the water. Fishes tolerated 100 times as much fluoride as is prescribed by the drinking water standards.

The traditional approach to stream pollution in terms of oxygen depletion by wastes has been partially supplanted by an approach based on the behavior and effects produced by specific pollutants. In terms of the material causing tastes and odors, multiple studies by the carbon filter technique of the troublesome materials actually present in drinking water has shown these materials to be "neutral" organic materials, largely hydrocarbon in nature. Related studies of the persistence of oily materials in water has shown that while these materials can undergo "self purification," such action is relatively slow.

Insecticides, of high toxicity to fishes, have been observed to enter streams in significant quantities. Dieldrin is used at the rate of about 5 pounds per acre for the control of the white fringed beetle. In one series of observations, run-off from land so treated was observed to be toxic to fishes in 1 - 3 dilution. Concurrent chemical studies developed techniques for the isolation, identification, and quantitative determination of the few parts per billion of the chemical present. These techniques employ concentration by adsorption on activated carbon or extraction with selective solvents, followed by chromatographic separation, and identification and quantitative measurement using infrared techniques. Similar procedure applicable to DDT and Chlordane have been developed.

The developing techniques of adsorptive concentration, or extractive concentration, followed by definitive characterization are beginning to pinpoint pollutional materials causing difficulties in water use. In many

instances "Pollution" is emerging from the non-specific cloak of "B.O.D." and assuming specific chemical identity, and definite toxicological and organoleptic properties with limited numbers of possible sources. Concentration of these materials has made possible bioassay of the health hazards attached to pollutional chemicals in the environment. Studies made by the National Cancer Institute of organic chemicals recovered from four water supplies indicate a trend -- resolution and concentration of possible adverse factors in the environment for further medical and toxicological consideration and investigation.

FIELD ACTIVITIES IN WATER POLLUTION, WATER PURIFICATION, AND WATER QUALITY CONTROL

The field surveys and technical services program of the Center is concerned with fact finding on problems of primary interest in the local geographical area affected. However, the results obtained and the field survey methods employed are usually of broad interest. This activity includes special engineering and mobile laboratory field studies, technical consultation services, and laboratory analytical services.

Stream Surveys

Stream surveys associated with Public Health Service participation with other Federal and State agencies concerned with water and land resource development have been conducted throughout the year.

Water Supply Studies

Under agreement with the Atomic Energy Commission, studies of the Scioto River to ascertain the condition of the stream for use as a water supply to serve the AEC Portsmouth, Ohio plant were conducted in September and October and again in the cold winter months.

Stream Pollution

Special carbon filter studies were made of the international boundary waters in Michigan to study trace quantities of organic compounds in the water, some of which produce tastes and odors in drinking water.

The survey of the Roanoke River in Virginia and North Carolina between John Kerr Reservoir and Williamston, N. C. was conducted to determine: (1) the fish food and fish population present and the toxicity of the industrial wastes on Blue Gill Fry; (2) the deoxygenation occurring; and (3) the volume and characteristics of the pulp and paper mill wastes and other wastes

entering the River.

Industrial Waste Studies

Engineering investigations and conferences were conducted at 44 industries in the boundary waters of the Buffalo-Tonawanda-Niagara Falls, New York area. This included analytical studies to obtain data as a basis for evaluating improvements made by industry in abating boundary water pollution.

Engineering assistance was given to New York State on evaluating the benefits to International Boundary Waters that could be expected from increasing the minimum flow in the Buffalo River which enters the Niagara River at Buffalo, New York.

Work was continued on developing industrial waste guides for the Steel Rolling Mills, the Blast Furnace Department of the Steel Industry, and Kraft Pulp and Paper Plants. Surveys at five steel mills in the Youngstown, Ohio area were made in conjunction with this program to determine the concentration of phenols in blast furnace gas wash water.

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MILK AND FOOD

Studies of shellfish characteristics in progress for several years culminated in a notable series of reports. The coliform organism has received further confirmation in its role of a suitable indication of pollution by enteric pathogens. Examination of the changes in the bacteriological quality of shellfish during harvesting and marketing has served to dramatize the deterioration of bacteriological quality during these operations. Studies of the interrelationship of water quality and shellfish quality have demonstrated extreme differences in bacteriological characteristics of different shellfish species under different environmental conditions. Among shellfish held in water of the same quality, clams will be poorest, quahogs of better quality and oysters still better.

The factors influencing the variable bactericidal efficiency of quaternary amines in sanitizing procedures appear to have been largely explained. Briefly, it has been found that the principal cause of the variation of the efficiency of this type of sanitizing agent in various types of waters relates directly to the hardness of the water. Perimeters for hardness which does not seriously interfere with quaternary amines have been established. It has been further established that softening of hard water makes it compatible with effective use of quaternary amines. Specific hardness complexing agents, compatible with the specific quaternary also render these agents effective in hard water. The use of quaternary amines in sanitizing operations related to milk and food handling equipment has appeared to offer distinct advantages. These findings will permit desirable operational procedures to be adopted while taking away the need for cumbersome studies required to demonstrate their applicability and points out

measures required to make the quaternaries suitable in waters not initially compatible with their use.

This year Congress first authorized expenditure of funds for activities related to the expediting of interstate milk shipment. This has required the examination of the technique and facilities of laboratories making examination of the bacteriological quality of milk for interstate shipment, and has led to a program of examination and certification of Central State laboratories for milk examination. In all, 30 of the 32 States affected were visited. An important part of the program has been to assist and stimulate States in setting up programs for review of the total intrastate milk laboratory activity related to certification of milk for interstate shipment. Inauguration of this program has taken up much of the energy of the Milk and Food Section this year.

GENERAL TECHNICAL PROGRESS

The identification of bacteria is a matter of great interest from the standpoint of air, water, food, and epidemiological and medical practices. Procedures have been devised for standardized preparation of bacterial films having reproducible infrared absorption spectra. To date, 468 standardized infrared spectra have been obtained on 188 strains of 78 species of 17 genera of bacteria all of which have been identified by morphologic, biochemical and/or serologic tests. A coding system has been devised by which standardized infrared spectra of bacteria can be precisely punched into an IBM card for rapid mechanical sorting and comparison. Using these procedures, data have been accumulated which demonstrate the reproducibility of standardized spectra and their usefulness in differentiation and identification of bacteria.

RADIOACTIVITY AS AN ENVIRONMENTAL CONTAMINANT

Studies of radioactivity permeate the air, water and waste studies carried on at the Center. For instance, studies of the radioactivity of particulates in air have already been mentioned. Radioactive materials also offer a potent tool for investigation. Radioactive phenol containing a radioactive carbon atom, for instance, has been used to make searching studies of the mechanism of absorption of material.

Studies made this year at Oak Ridge National Laboratories include the investigation of many combinations of coagulation and/or absorption by clay for purification of radioactive wastes. Other processes investigated include ion exchange with organic exchangers operated on different cycles. The results show a complex interplay of the chemistry of a particular radioactive material, its physical condition and the treatment process applied as factors determining process efficiency. Coagulation processes are efficient in removing colloidal material and may be effective on some dissolved materials which are removed by adsorption or co-precipitation. Ion exchange operations find their best use in removal of dissolved ions. Clays and soil in sufficient amount are effective in removing most fission products or wastes of atomic industry by percolation. Perm-selective membranes show promise for decontamination of certain dissolved wastes, and for concentration of traces of radioactivity to facilitate analysis.

Percolation of low level wastes into soils emerged as one promising process for effective disposal of radioactive wastes. Studies show very little travel of such material through suitable soils, and material reaching the ground water has little radioactivity even at points close to the percolative entrance of the waste. Investigation of this type of

waste disposal must, of necessity, be very detailed and thorough before such a process can be recommended because of the possibility of radioactive pollution of ground water.

Investigation of the radioactivity of rain in Cincinnati subject to radioactive contamination by bomb testing has shown ponderable amounts of radioactive material in the rain. This radioactivity, while not presently at such levels as to offer health hazard, has introduced another new factor in the environment. It is interesting to note that rainfall over a few square miles can deposit curie amounts of radioactivity. Thus, in 1953, in the period between March 19 and June 10, it is estimated that 13.5 curies of activity were deposited by rainfall on each square mile in the Cincinnati area. Surface and cistern waters examined following rains having an activity of 50 to 500 times background showed an activity of only three times background.

Along with other investigations, Center studies have shown very significant biological concentration of radioactivity in aquatic environments. In the Columbia River, the aquatic fauna and flora showed a capacity for a high degree of concentration of radioactive materials as the result of physical absorption and/or metabolic activity. Maximum concentration factors for gross beta activity varied from about 10,000 in the case of the plankton to about 800 in the case of resident species of fishes. In the case of specific isotopes such as P^{32} much higher figures are observed. Other studies have shown again that biological concentration factors are specific in terms of biological species and radioactive element. It is apparent that the radioactive contamination of environmental conditions, while not now offering ponderable hazard, will require close and continued scrutiny.

TRAINING

Sanitation Training

During the past year special attention has been given to the problem of developing a comprehensive program dealing with the biological aspects of water pollution control. Although this program has been designed to increase the effectiveness of the professional biologists, the necessity of orienting professional people in other fields in the biological approach has been recognized also. Five biological short courses have been developed in this connection.

The release of the results of the studies on individual household sewage disposal systems by the Center created an insistent demand for the seminar offered in this field. This seminar was given once at Cincinnati and three times in the field during fiscal year 1954, and has already been scheduled to be given at least eight times in 1955.

Interest in the milk and food program has continued at a high level and seems to be progressively increasing; and there is a continuing demand for field courses on the membrane filter.

It was estimated by the 195 trainees who attended the courses presented by the Advanced Sanitation Training Section at Cincinnati that, on returning home, they would contact in excess of 7,000 people in connection with the dissemination of this technical information.

Field Activities

In response to continuing demands from the States, there has been an increase in the presentation of courses and seminars outside of Cincinnati. The demand in general has been for such topics as water

pollution control--industrial wastes, membrane filter techniques, fluoride analysis, nuisance organisms in water supplies, and the seminar on individual household sewage disposal systems. Through this program of field offerings, many more people were accommodated than were able to come to Cincinnati.

This field training program has involved 18 courses in 18 States, with 647 trainees enrolled. This is more than three times the number trained at Cincinnati. The demand for this type of training has grown to the point where scheduling is necessary almost a year in advance.

Analytical Reference Service

A chemical analytical reference service program in the field of water analysis has been inaugurated at the Center to permit a State laboratory to make a performance evaluation of its efficiency in water analysis. In an evaluation, several laboratories cooperate in an individual examination of portions of an identical sample. The details of this program were worked out initially in cooperation with the State of Arkansas, and the first sample was run in the States of Ohio, Pennsylvania, Maryland, Louisiana, Texas, Oklahoma, and the U. S. Geological Survey National Laboratory in Columbus, Ohio. Additional States have requested this service.

FORMAL TRAINING COURSES CONDUCTED AT
THE SANITARY ENGINEERING CENTER
July 1, 1953 to June 30, 1954

DATE	DURATION OF COURSE (EQUIVALENT DAYS)	TITLE	TOTAL ENROLLMENT	REPRESENTATION				
				INSTITUTIONS	STATE & LOCAL	INDUSTRIAL	FEDERAL AGENCIES	FOREIGN COUNTRIES
September 17-18	2	Short Course in Fluoride Analysis	12	- -	8	- -	1	- -
September 23-25	3	Seminar on Household Sewage Disposal Systems	31	2	9	2	3	1
October 13-16	4	Membrane Filter in the Bacteriological Analysis of Water	12	1	6	- -	3	- -
November 2-6	5	Nuisance Organisms in Water Supplies	10	- -	7	1	- -	- -
Nov. 30-Dec. 11	10	Advanced Training for Sanitary Chemists in Water Pollution Investigation	15	- -	11	1	2	1
January 18-22	5	Advanced Training in Bacteriological Examination of Milk & Dairy Products	17	1	10	- -	2	- -
January 25-29	5	Food Sanitation Training	15	2	7	1	3	- -
March 8-19	10	Advanced Training for Sanitary Engineers in Water Pollution Abatement Programs	28	1	17	10	2	1
April 21-23	3	Seminar on Household Sewage Disposal Systems	17	- -	3	1	- -	- -
April 27-30	4	Membrane Filter in Bacteriological Analysis of Water	12	- -	6	- -	2	1
May 5-7	3	Analysis of Metals in Industrial Wastes	13	- -	9	6	- -	- -
June 8-11	4	Advanced Training for Aquatic Biologists	13	1	8	2	- -	- -
			195	8	101	24	18	4

Sponsoring Agencies of Cincinnati Trainees	Number	Per Cent
State governments	76	38.8
County governments	8	4.1
Municipalities	22	11.3
Industry	24	12.6
Institutions	6	3.0
Territories and possessions	5	2.5
Foreign countries	4	2.0
Total non-federal	145	74.3
Military	7	3.6
D. C.	1	0.5
P.H.S.	18	9.2
Other bureaus	24	12.6
Total federal	50	25.9
Professional antecedents of trainees		
College graduates	114	58.4
Holders of advanced degrees	57	29.2
Engineers	82	42.0
Biologists	13	6.6
Bacteriologists	31	15.9
Chemists	41	21
Others	28	14.3

RADIOLOGICAL HEALTH TRAINING

The radiological health training activities have shown much the same trends as the sanitation training courses. Student calibre has been high, and the impact of instruction is not limited to the student informed. In the interest of brevity, a breakdown of the qualifications, background, hours of training, etc., is omitted from this section.

A summary of the courses offered is as follows: 9 resident courses, offered in Cincinnati in fiscal year 1954 were attended by 114 students representing 29 States and Canada. Thirteen field courses, given in 8 different States accommodated 314 students.

Courses Offered

Nature of Course	Cincinnati	Field
Basic	3	1
Intermediate	2	
Advanced	1	
Waterworks Short Course	1	4
Occupational Health Personnel		2
Industrial Hygienists		1
Health Officers		1
Seminar		4
Special	2	

The courses summarized have been adapted primarily to meet the needs of State and local health department personnel. A considerable portion of the persons trained, however, reflects the growing interest

in radiation hygiene that is being manifested by industry, universities, the Armed Forces, and various government agencies.

In addition to actual training activities, staff members provided consultation and information services as well as technical assistance to various groups and organizations concerned with specific radiological health problems.

A major auxiliary activity of the Section was concerned with a revision and reproduction of the publication, "Radiological Health Handbook." During the fiscal year there were requests for 2600 copies of the Handbook.